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AUTHORITY

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MECHANICAL-PROPERTY DATA
HP 9Ni-4Co-25C
STEEL

Tempered Plate

Issued by

Air Force Materials Laboratory
Research and Technology Division
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

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Prepared by

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Columbus Laboratories
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This data sheet was prepared by Battelle Memorial Institute under Contract AF 33 (615)-2494. The contract was initiated under Project No. 7381, "Materials Application", Task No. 738106, "Design Information Development". The major objectives of this program are to evaluate newly developed structural materials of potential Air Force weapons-system interest and then to provide data-sheet-type presentations of mechanical data. The program was assigned to the Structural Materials Engineering Division at Battelle under the supervision of Mr. Walter S. Hyler. Project engineer was Mr. Leman Beall, Jr.. The program was administered under the direction of the Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, by Mr. Marvin Knight, project engineer.

Notices

HP 9-4-25

The HP 9-4-25 alloy is a nickel-cobalt quenched and tempered martensitic steel possessing excellent toughness at yield-strength levels up to about 200 ksi. This alloy was designed for use as plate, structural sections and forging applications. It is especially suitable for highly stressed structures requiring good material reliability and weldability.

This steel is sensitive to thermal-mechanical treatments. In particular, both the strength and toughness can be increased by hot-cold working.

The alloy is available as sheet, plate, wire, rod, bar, and forging.

HP 9-4-25 PLATE DATA[a]

Condition: 1025 F Temper[b]
Thickness: 0.25 inch

Properties	Temperature, F			
	RT	500	700	900
Tensile				
F_{tu} (longitudinal), ksi	197	182	165	138
F_{tu} (transverse), ksi	197	183	166	138
F_{ty} (longitudinal), ksi	184	161	146	123
F_{ty} (transverse), ksi	185	162	147	123
e_t (longitudinal), percent in 2 in.	15	16	15	15.7
e_t (transverse), percent in 2 in.	15.5	16	15.2	16.5
E_t (longitudinal), 10^6 psi	27.3	25.7	24.1	21.5
E_t (transverse), 10^6 psi	27.8	26.2	26.0	22.9
Compression				
F_{cy} (longitudinal), ksi	200	178	164	134
F_{cy} (transverse), ksi	197	178	164	134
E_c (longitudinal), 10^6 psi	30.1	28.7	27.7	25.7
E_c (transverse), 10^6 psi	28.9	27.7	26.4	24.8
Impact				
(V-notch Charpy), ft-lb[1]*	35-50	U[c]	NA[d]	NA
Fracture Toughness	(e)	NA	(e)	NA
Shear, F_s				
(Longitudinal), ksi	128	U	U	U
(Transverse), ksi	128	U	U	U

*See references at end.

Properties	Temperature, F			
	RT	500	700	900
Axial Fatigue				
(Transverse)				
10^3 (K_t = 1)(R = 0.1), ksi[f]	202	210	208	U
10^5 (K_t = 1)(R = 0.1), ksi	156	170	165	U
10^7 (K_t = 1)(R = 0.1), ksi	140	158	150	U
10^3 (K_t = 3)(R = 0.1), ksi	180	175	188	U
10^5 (K_t = 3)(R = 0.1), ksi	66	60	70	U
10^7 (K_t = 3)(R = 0.1), ksi	60	55	62	U
Creep				
(Transverse)				
0.5% elongation 100 hr, ksi	NA	(g)	135	80
0.5% elongation 1000 hr, ksi	NA	(g)	130	64
Stress Rupture				
Rupture 100 hr, ksi	NA	(g)	150	100
Rupture 1000 hr, ksi	NA	(g)	138	68
Stress Corrosion				
80 percent F_{ty} 1000 hr max	No cracks[h]	U	U	U
Coefficient of Thermal Expansion				
68 to 800 F (2)	6.4×10^6 in./in./F			
Density (2)	0.28 lb/in.^{3}			

(a) Data are from tests conducted at Battelle under the subject contract unless otherwise indicated. In most cases data are average values for three tests. Fatigue, creep, and stress-rupture values are from data curves generated using the results of a greater number of tests.

(b) Treatment: 1 hr at 1600 F AC; 1 hr at 1525 F OQ; 2 + 2 hr at 1025 F.

(c) Information unavailable.

(d) Information not applicable.

(e) Fatigue-cracked single-edge-notched specimen (2" x 8" at RT, 2" x 13-1/4" at ET) failed in ductile manner. Nominal notch strength 100 to 103 ksi.

(f) "K_t" represents Neuber-Peterson theoretical stress-concentration factor. "R" represents algebraic ratio of the minimum stress to the maximum stress in one cycle, that is, $R = S_{min}/S_{max}$.

(g) Steel did not go to 0.5% elongation or to rupture at 500 F when stressed to tensile yield-strength level.

(h) Alternate immersion, 3-1/2% NaCl.

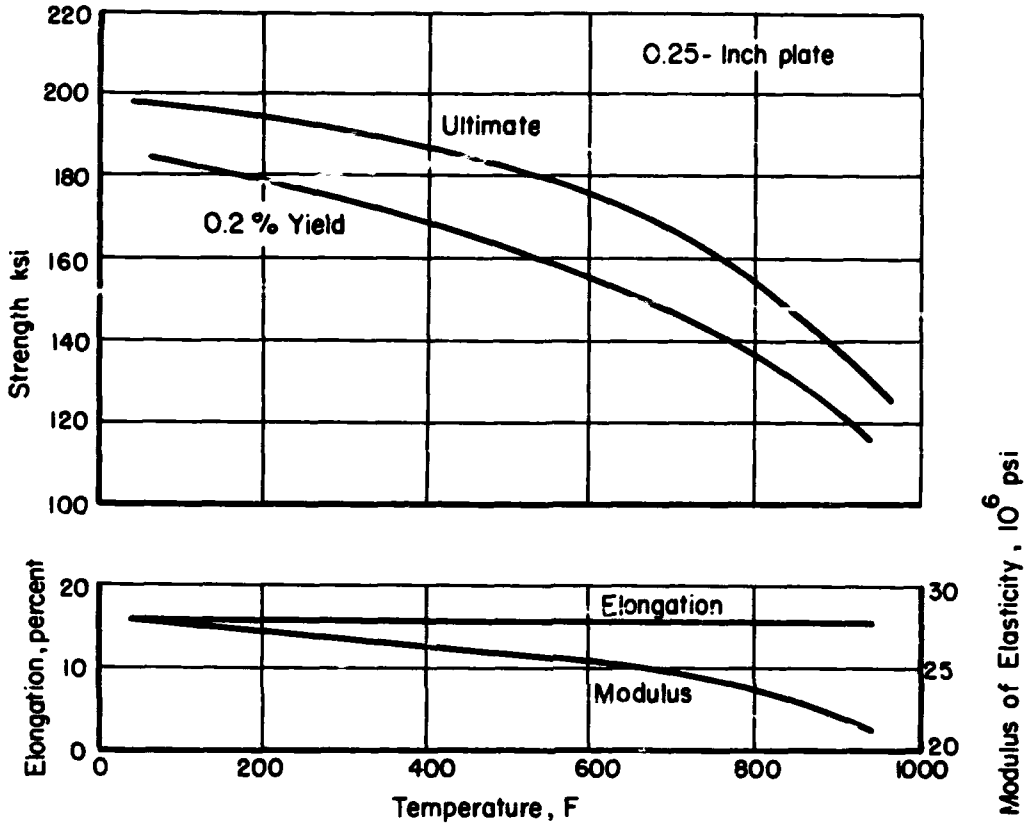

FIGURE 1. EFFECT OF TEMPERATURE ON THE TENSILE PROPERTIES OF QUENCHED AND TEMPERED HP 9-4-25 PLATE

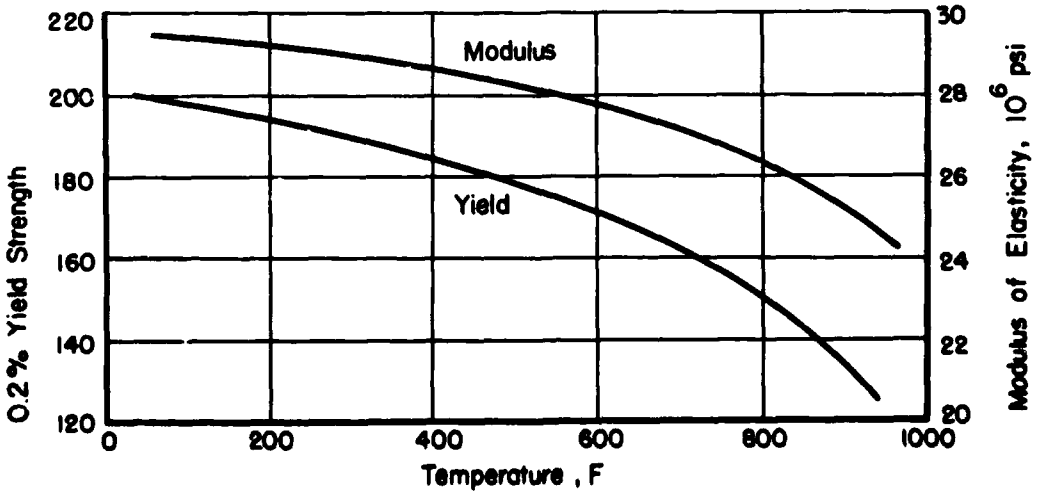

FIGURE 2. EFFECT OF TEMPERATURE ON THE COMPRESSION PROPERTIES OF QUENCHED AND TEMPERED HP 9-4-25 PLATE

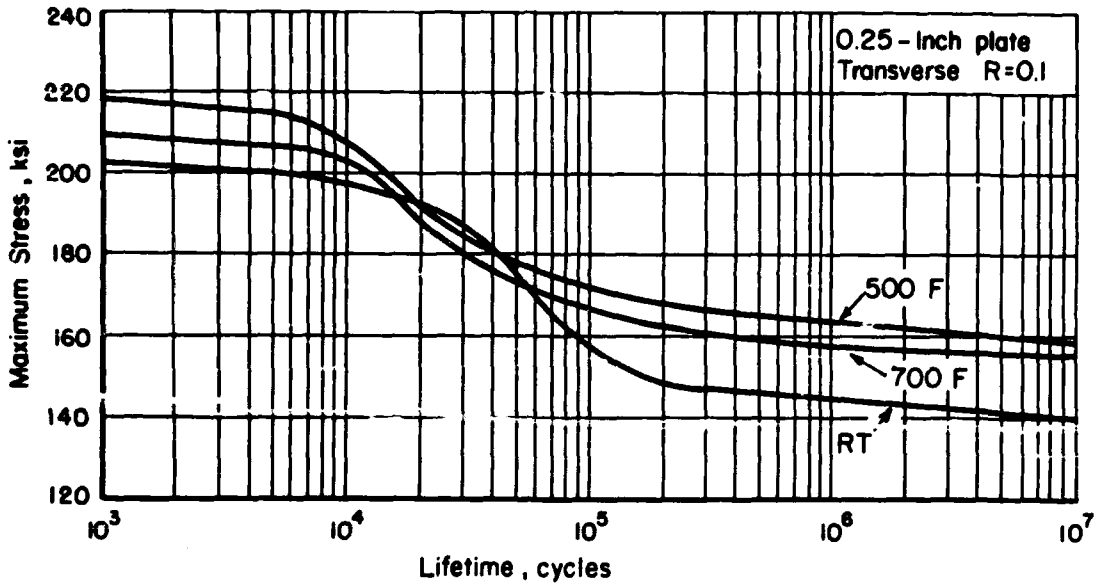

FIGURE 3. AXIAL-LOAD FATIGUE RESULTS FOR QUENCHED AND TEMPERED HP 9-4-25 PLATE AT THREE TEMPERATURES

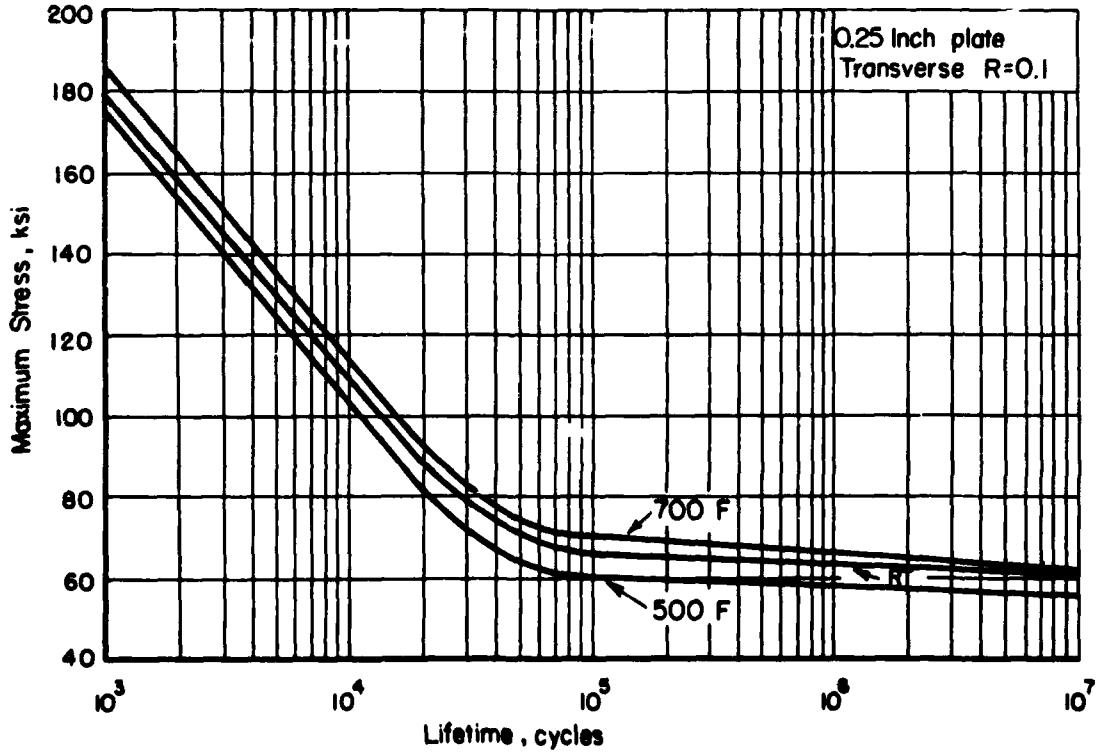

FIGURE 4. AXIAL-LOAD FATIGUE RESULTS FOR NOTCHED (K_t = 3.0) QUENCHED AND TEMPERED HP 9-4-25 PLATE AT THREE TEMPERATURES

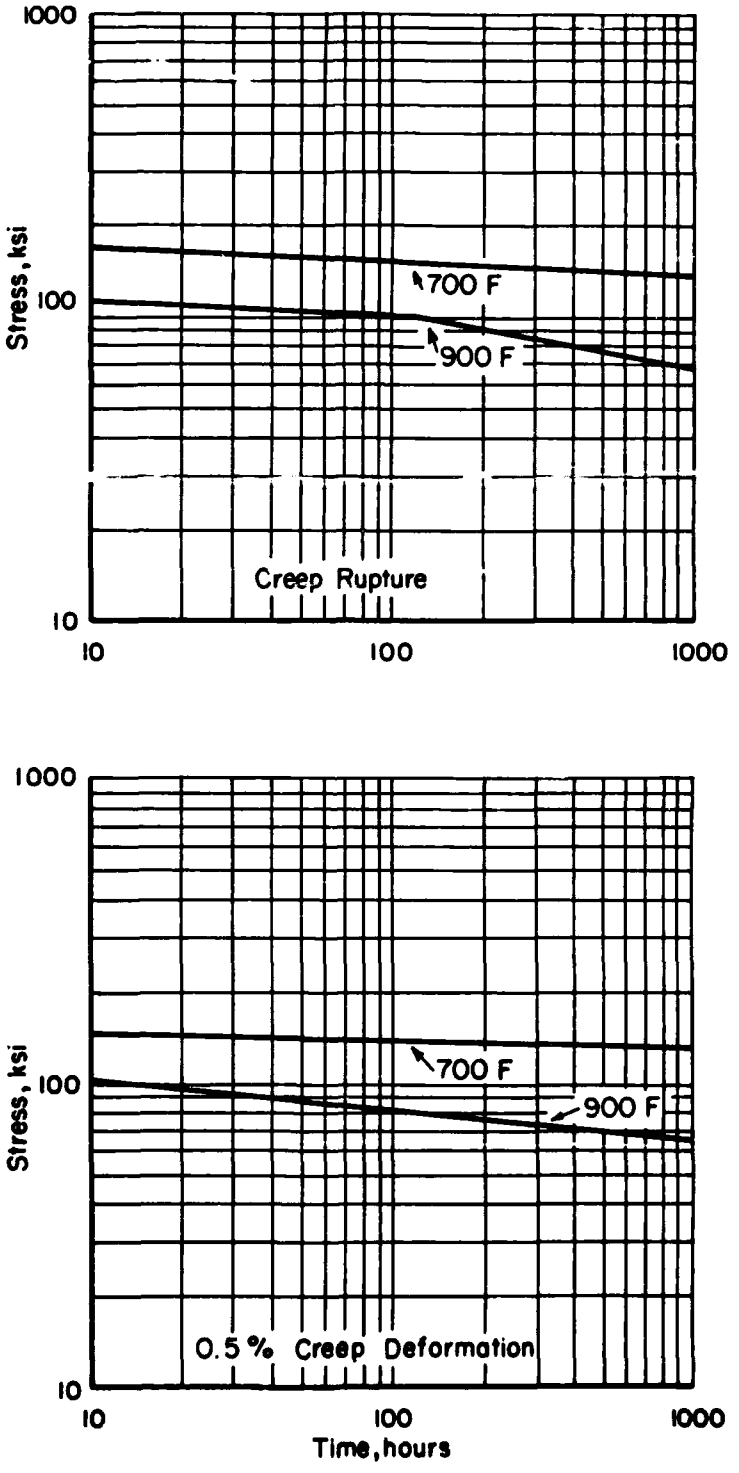

FIGURE 5. STRESS-RUPTURE AND 0.5% DEFORMATION CURVES FOR HP 9-4-25 PLATE (0.25-INCH) AT TWO TEMPERATURES

REFERENCES

(1) Pascover, J. S., and Matas, A. J., "Properties of HP 9-4-X Alloy Steels", WADC TDR 64-225 (1964).

(2) "Preliminary Technical Data on the Republic Hi Performance Steels", Republic Steel Brochure.